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Gonsalves

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(54) **AUTOMATICALLY PERSONALIZING APPLICATION USER INTERFACE**

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G06F 3/0482 (2013.01)
G06F 17/30 (2006.01)

(52) **U.S. Cl.**
CPC **G06F 3/0482** (2013.01); **G06F 17/30867** (2013.01); *G06F 2203/04803* (2013.01)

(58) **Field of Classification Search**
CPC G06F 3/0482
USPC 715/745
See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — Fish & Richardson P.C.

(57) **ABSTRACT**

A computer-implemented method for automatically personalizing applications includes: receiving, in a computer system, user behavior data for multiple users of at least one application program, the application program having a user interface with multiple input controls displayed on multiple different panes, and the user behavior data reflecting actions performed using the input controls on the panes; identifying, using the computer system, at least one usage pattern in the user behavior data as meeting a usage pattern criterion; storing a personalization record based on identifying the usage pattern, the personalization record specifying the usage pattern as a sequence of activating at least some of the input controls on at least some of the panes; and automatically generating, using the computer system and based on the personalization record, a modified user interface according to the identified usage pattern.

18 Claims, 13 Drawing Sheets

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Editing: RFx Setup: Delivery Info

✓ Done   💾 Save   ✗ Cancel   ↶ Undo

| General | Scoring | Pricing Model | **Delivery Info** | Line Item Specifications | Supplier-Entered Attributes | Groups | Notifications |

⌐ 102A

⌐ 102

Delivery Information

104

Inco Terms: ▦ Add Inco Terms   🗑 Delete Selected

☐   **Inco Terms**

☐ 🗑 Cost and Freight

☐ 🗑 Delivered Duty Paid

☐ 🗑 Free On Board

⎫ 106

Line Item Period Type: Year

Delivery Schedule: ▦ Add Delivery Period   🗑 Delete Selected

☐   Delivery Periods

☐ 🗑 Year 2010

⎫ 108

⌐ 100

FIG. 1A (Prior Art)

110

Editing: RFx RFP-00001-BGNXM-2010: Monthly Office Supply Sourcing

✔ Done   💾 Save   💾 Save and New   ✗ Cancel   ↰ Undo   Document▴   Actions▴   Reports▴   *110*

🗋 Attachments   🗩 Discussions   🗩🗩 Chat   →🗋 Created   ☆ Favorites

Header	Exchange Rates	Schedule	Suppliers	Information	Specs	Questions	Line Items	Accounting

114A

Current Phase:	Created	↯ *114* *112*
ID:	RFP-0001-bgnxm-2010	
* Title:	Monthly Office Supply Sourcing	*116A*
Description:	▲ ▼	*116B*
	0 of 256 characters	
Document Type:	RFP	
Company:	Biogenyx Medical	
Organizational Unit:	⧉	*116C*
Location:	Boston Office ⧉	*116D*
* Product Category:	Office Supplies ⧉	*116E*
External Category:	⧉	*116F*
Currency:	USD	
Estimated Value:	USD	*116G*
Budgeted Value:	2,500.0000 USD	*116H*
	☑ Enable Multiple Rounds	
Round Name:	None ▼	*116I*
* Default Rank For RFx Responses:	Total Cost ▼	*116J*

116

General Status

Total number of Line Items:	4
Total Number of Questions:	14

118

Collaborators

120

🖳 Add Users 🖳 Add Groups 🖳 Add Company 🗑 Delete Selected						
☐	**Name**	**Type**	**E-mail**	**Role**	**Representative**	**Authorization**
☐ ✐ 🗑	Mike Gonsalves	User		Owner	Purchasing	readWrite

Document Links

122

🖳 Add 🗑 Delete Selected		
Name	**Title**	**Relationship**

Change History

124

Created By:	Mike Gonsalves 12/1/10 3;51 PM (EST)
Last Changed By:	Mike Gonsalves 12/2/11 32 AM (EST)

FIG. 1B (Prior Art)   ↯ *100*

Editing: RFx RFP-00001-BGNXM-2010: Monthly Office Supply Sourcing

✓ Done 🖫 Save 🖫 Save and New ✗ Cancel ↷ Undo Document▲ Actions▲ Reports▲ 📎Attachments ♡ Discussions ♡♡ Chat ⬆⬅Created ☆⬈ Favorites *110*

Header | Exchange Rates | Schedule | Suppliers | Information | Specs | Questions | Line Items | Accounting

114B

126

Phase: Created ⬋*114*

* Phase Configuration: ○ All Phases   *128*
                         ○ Skip Open for Review
                         ○ Skip Waiting for Approval
                         ○ Skip Waiting for Approval and Open for Review

Standard Dates

130

Planned Open Date: ▣ [   ] am ▶ ⌐*132A*
                           ☐ Automatic phase change on planned open date ⌐*132B*

Intention to Respond Date: ▣ [   ]   *132C*

RFx Response Due Date: ▣ [12/31/10] ▣ [6:00] pm ▶ ⌐*132D*
                           ☐ Automatic phase change on due date
                           ☐ Skip Preliminary state on RFx Response   *132E*
                           ☐ View RFx Responses Only After Bidding Closes   *132*

Date to Publish Notice: ▣ [   ]   *132F*
                           ☐ Publish Notice to All Suppliers ⌐ *132G*

                   * Base Date: ▣ [12/1/10]   *132H*

Events in bold are current events. Events in red are behind schedule.

Schedule Items

Setup View ▼   *134*

📑 Add 🗐 Import from Library ↻ Reorder List

Name	Phase	Event Type	Duration	Start Type	Fixed at	Publish to Calendar	Required	Shared With Suppliers	Owner
🖉🏛 RFx Response Due	Open For Response	Task	1	Fixed	12/31/10	☑	☐	☑	

⬎*100*

FIG. 1C (Prior Art)

Editing: RFx RFP-00001-BGNXM-2010: Monthly Office Supply Sourcing   <u>110</u>

✔ Done 📀 Save 📑ˣ Save and New ✘ Cancel ↰ Undo Document⬦ Actions⬦ Reports⬦ 🗓Attachments ⏻Discussions ⬡⬦Chat ⬆📄Created ⭐Favorites

| Header | Exchange Rates | Schedule | **Suppliers** | Information | Specs | Questions | Line Items | Accounting |

Invited Suppliers   <u>136</u>

⬒ Add 🗑 Delete Selected   Assign Line Item Visibility

	Supplier ID	Supplier Name	Supplier Contact	E-Mail	Status	Event Multiplier	Event Additive Value 1	Event Additive Value 2
☐	🗑 VEN-000003	Office Depot	Denny Daniels		Initial	[ ] %	[ ] USD	[ ] USD
☐	✏🗑 VEN-000001	Office Max	Max Maximillian		Initial	[ ] %	[ ] USD	[ ] USD
☐	✏🗑 VEN-000004	Staples	Susan Santos		Initial	[ ] %	[ ] USD	[ ] USD
☐	✏🗑 VEN-000002	WB Mason	Madison Mason		Initial	[ ] %	[ ] USD	[ ] USD

<u>138</u>

<u>114</u>

Instructions: Set the following disclosure rules to determine how much competitive information is shared with suppliers

Rank: ◯ Do not disclose rank
       ◯ By quartile
       ◯ Do not show total number participating
       ◯ Show total number participating

Supplier Invitation Attachment: [   ] 📑 *142*

Event Terms

⬒ Add 📚Import from Library 🗑 Delete Selected   <u>144</u>

Display Name	Terms Text

⌐ 100

FIG. 1D (Prior Art)

Editing: Questions Section : RFP Questions

✓ Done   🖫 Save   🖫 Save and New   ✗ Cancel   ↰ Undo   1 RFP Questions◢   Next ⊙   Actions◢ ⌐ *150*   *110*

Question Summary	Section Info	Preview	Preferences

* Question Section Name: | RFP Questions |

* Status: | Ready for Release ▼ | *146*

Questions

| Summary View ▼ | *148* |

| Free Text ▼ | 🖹 Add   🖹 Import from Library   🗑 Delete Selected   Add Group   ⟳ Reorder List |

☐	#	Question	Type	Contributes to Total Cost	Contributes to Total Price	Response Required
▼✎🗑	1.1 General Questions					
☐✎🗑	1.1.1	Is this a Minority-Owned Business?	Yes or No Question	☐	☐	☑
☐✎🗑	1.1.2	Is this a Woman-Owned Business?	Yes or No Question	☐	☐	☑
☐✎🗑	1.1.3	In which year were you founded?	Number	☐	☐	☑
☐✎🗑	1.1.4	Do you have an E-Commerce Site?	Yes or No Question	☐	☐	☐
☐✎🗑	1.1.5	How many B&M Stores do you have?	Number	☐	☐	☐
☐✎🗑	1.1.6	In which of these states do you have stores?	Multiple Choice	☐	☐	☐
▼✎🗑	1.2 Discounts					
☐✎🗑	1.2.1	Do you offer discounts for volume sales?	Yes or No Question	☐	☐	☑
☐✎🗑	1.2.2	Do you offer discounts for repeat customers?	Yes or No Question	☐	☐	☑
▼✎🗑	1.3 Taxes					
☐✎🗑	1.3.1	Do you collect sales tax for internet sales?	Yes or No Question	☐	☐	☑
▼✎🗑	1.4 Shipping					
☐✎🗑	1.4.1	Do you offer free shipping?	Yes or No Question	☐	☐	☑
☐✎🗑	1.4.2	Do you offer free return shipping?	Yes or No Question	☐	☐	☑
▼✎🗑	1.5 Returns					
☐✎🗑	1.5.1	Do you charge a restocking fee for ret. items?	Yes or No Question		☐	☑
▼✎🗑	1.6 Customer Support					
☐✎🗑	1.6.1	Please describe your customer support options	Free Text	☐	☐	☑
☐✎🗑	1.6.2	What are the hours of operation for customer support?	Free Text	☐	☐	☑

FIG. 1E (Prior Art)

100

FIG. 1F (Prior Art)

Welcome M. Gonsalves   My Settings Help About Setup Reference   Log Off

Quick Create▼   Recent Items▼   Favorites▼   Search [   ] In [▼] Go   Advanced

| Project Management | Enterprise Sourcing | Contract Management | Supplier Management | Express | Reports |

RFx > Monthly Office Supply Sourcing

Editing: RFx RFP-00001-BGNXM-2010: Monthly Office Supply Sourcing

✓ Done   💾 Save   💾 Save and New   ✗ Cancel   ↰ Undo   Document⊿ Actions⊿ Reports⊿   *110*

📇 Attachments   💬 Discussions   💬 Chat   ➡📄 Created   ☆ Favorites   (REVIEW)⸛ *204*

Header | Questions | Line Items |

114A   *114C*   *114E*   * Title: [Monthly Office Supply Sourcing]⸛ *116A*
   202

Document Type: RFP

Location: [Boston Office   🗐]⸜ *116D*

* Product Category: [Office Supplies   🗐]
                                                            116E
Budgeted Value: [2,500.00] USD⸜ *116H*

* Default Rank for RFx Responses: [Total Cost   ▼]⸜ *116J*

Schedule

RFx Response Due Date: [12/31/10 🗓] [6:00   ] [pm ▼]⸜ *132D*

Suppliers

📇 Add 🗑 Delete Selected Assign Line Item Visibility

☐	Supplier ID	Supplier Name	Supplier Contact	E-Mail	Status
☐ ✎🗑	VEN-000003	Office Depot	Denny Daniels		Initial
☐ ✎🗑	VEN-000001	Office Max	Max Maximillian		Initial
☐ ✎🗑	VEN-000004	Staples	Susan Santos		Initial
☐ ✎🗑	VEN-000002	WB Mason	Madison Mason		Initial

138

Collaborators

📇 Add Users 📇 Add Groups 📇 Add Company 🗑 Delete Selected   *120*

☐	Name	Type	E-mail	Role	Representative	Authorization
☐ ✎ 🗑	Mike Gonsalves	User		Owner	Purchasing	readWrite

Change History   *124*

Created By: Mike Gonsalves 12/1/10 3:51 PM (EST)

Last Changed By: Mike Gonsalves 12/2/11 1:32 AM (EST)

FIG. 2

⸛ *200*

New Sourcing Event (RFP)

Next ⊙   ✗ Cancel   204 ⌇ (REVIEW)

302

Job Description   304

Enter summary information describing your job or project. Fields marked * are required.

* Title   Monthly Office Supply Sourcing   ⌇116A

* Quote Due Date: 12/31/10   6:00   pm ▶   ⌇132D   306

Budgeted Value: 2500   USD   ⌇116H

Line Items   308

Enter a brief description for each line item, e.g., pieces of services, which are part of your request. At least one line item is required.

Description   310

1   A11 Lab Notebook

2   Number 2 Pencil

3   Sharpie

4   V7 Precision Pen

⌇300

FIG. 3A

Enter Specification for Item 1

◉ Back   Next ⊕   ✗ Cancel   204 — ⬭REVIEW

302

Description

312

* Item Description: A11 Lab Notebook   154A

* Delivery Date: 1/11/10   6:00   pm ▶   154B

* Quantity: 200   EA ▶   154C

2 300

FIG. 3B

Submit *302*

⊙ Back ✓ Submit ✗ Cancel   *204* ⟋ (REVIEW)   314

Confirm that the request information is correct. If you are done, click the Submit button. If you do not want to submit this request for processing, click the Cancel button. To change Job Description or any other information, use the Back button on the top of the page.

Description   316

 * Title Monthly Office Supply Sourcing

 * Quote Due Date: 12/31/10 6:00 PM (EST)
   Budgeted Value: 2,500.00 USD

Line Items

To change a line item, click the line item description. To delete a line item, click the delete icon.   308

	Description	Quantity	
1	A11 Lab Notebook	200EA	🗑
2	Number 2 Pencil	300EA	🗑
3	Sharpie	200EA	🗑
4	V7 Precision Pen	500EA	🗑

Suppliers   318

	Supplier	Contact	E-Mail
☐	Office Depot	Denny Daniels	
☐	Office Max	Max Maximillian	
☐	Staples	Susan Santos	
☐	WB Mason	Madison Mason	

⟍ *300*

FIG. 3C
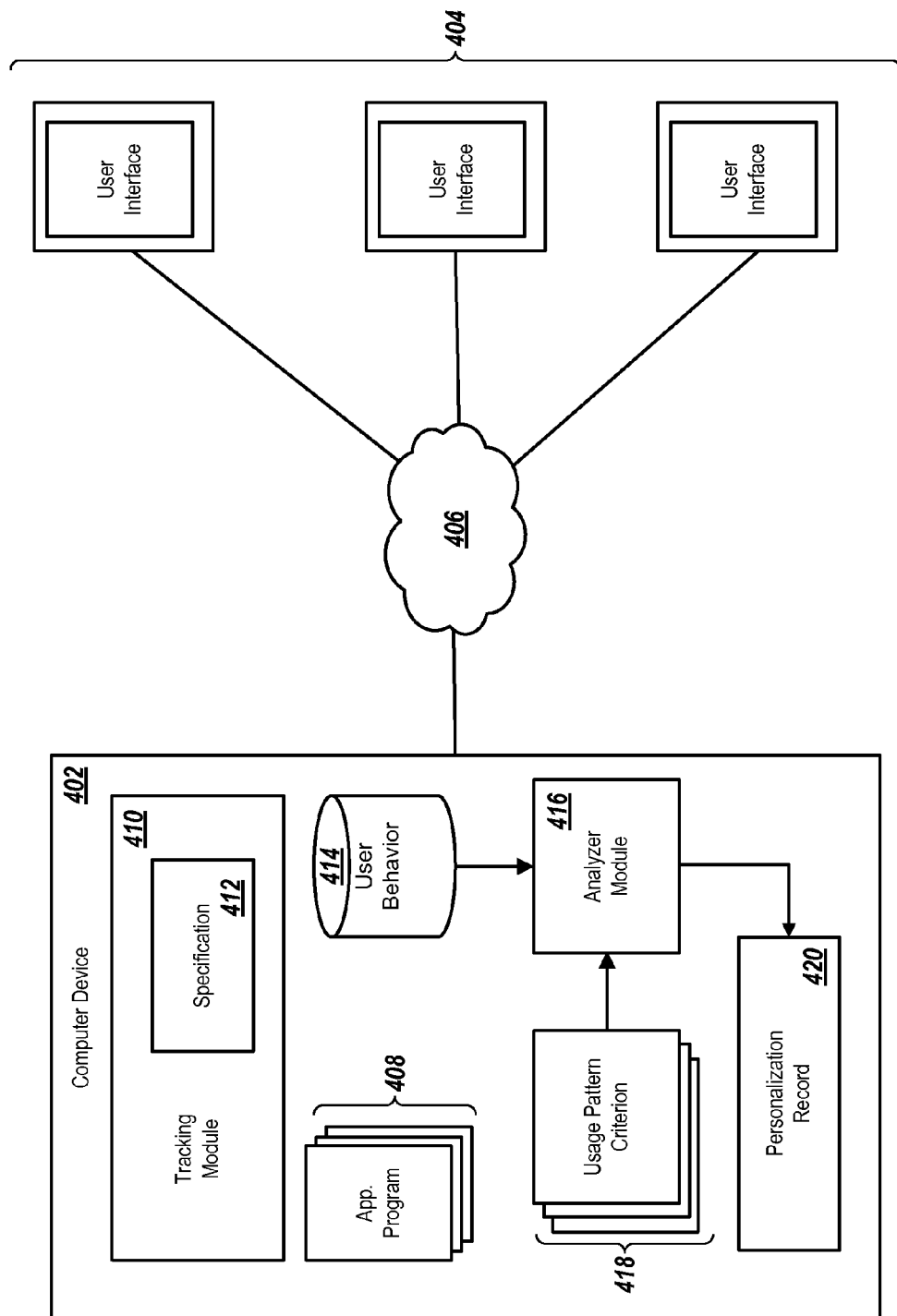
FIG. 4

	$User_1$		$User_2$		$User_3$		...	$User_N$	
$Aspect_1$	28th	3 s.	1st	2 mins.	---	---		1st	15 s.
$Aspect_2$	11th	7 mins.	38th	15 s.	17th	5 min.		2nd	2 mins.
$Aspect_3$	Mth	1 min.	9th	8 mins.	3rd	48 s.		39th	8 mins.
$Aspect_4$	---	---	---	---	---	---		---	---
. . .									
$Aspect_M$	2nd	28 s.	41st	18 s.	21st	8 min.		14th	29 s.
Total		22 mins.		19 mins.		12 mins.			31 mins.

502 504 506 500

FIG. 5

600

620

Memory

650

Processor
610

Storage Device
630

Input/Output
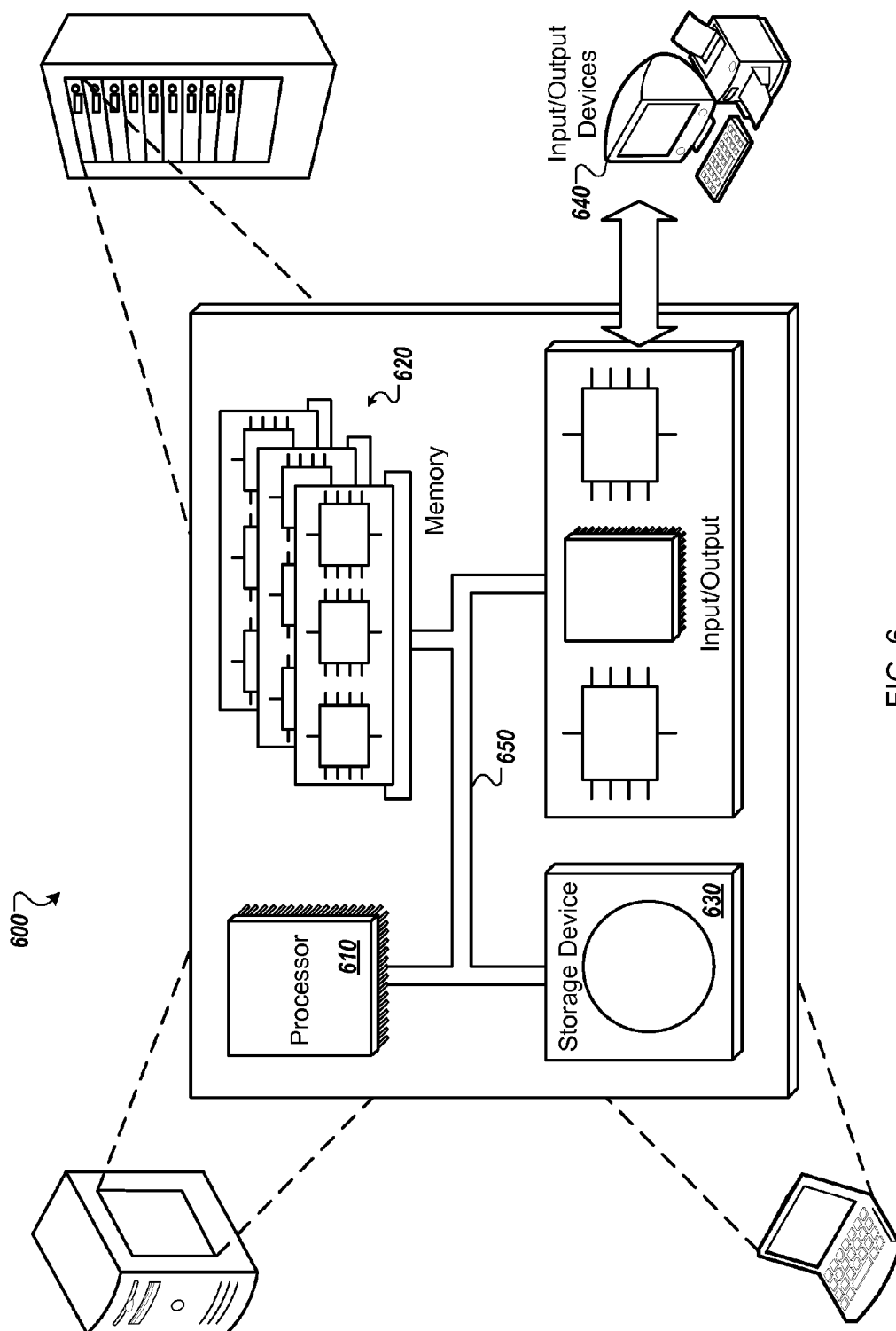
Input/Output
Devices

640

FIG. 6

AUTOMATICALLY PERSONALIZING APPLICATION USER INTERFACE

TECHNICAL FIELD

This document relates to automatically personalizing an application user interface.

BACKGROUND

Business applications, such as those used in the field of enterprise resource planning (ERP), are becoming more and more sophisticated and rich with features. As the functional scope of these applications broadens, sometimes their complexity increases and non-intuitive user interactions are added. Customers, in turn, spend a considerable amount of time customizing the application and modeling their business processes. Moreover, end users further personalize their view into the application to better suit their needs and daily usage habits. Personalization is sometimes correlated with user productivity. In some existing systems, parts of an application that a particular user does not need can be hidden, frequently used report fields that are typically not shown by default can be added, user interface (UI) elements can be reordered, to name some examples. However, such personalization can also be a time consuming process and the end result may still not yet be truly optimal.

As an illustration, consider an existing business process for sourcing materials to a large organization. FIGS. 1A-F show a prior art UI **100** for an application program. Such an application can host strategic sourcing projects for buyers across multiple independent enterprises. In this example, a buyer performs a recurring project to source office supplies at the end of each month. The project serves to create a corresponding business document, such as a request for proposal (RFP), a request for information (RFI), or a request for quote (RFQ). In each case, the user follows a similar workflow while the project is executed, navigating back and forth through various screens for the project. Assume that the user is here creating an RFP.

With reference now to F1A, the UI **100** is here configured for gathering delivery information for the RFP. That is, the UI **100** includes tabs **102** for various aspects of the project, and currently the user has selected a tab **102**A for "Delivery Info". The tab **102**A generates a pane **104** where the user enters delivery information. Particularly, the pane **104** includes input controls **106** where the user specifies information regarding Inco Terms for the RFP. Also, an input control **108** lets the user specify a delivery schedule for the RFP. When done with the pane **104**, the user can click "Done" in a toolbar **110**.

With reference now also to FIG. 1B, the UI **100** provides a pane **112** that requests more specific information about the RFP. The pane **112** corresponds to a particular selection that the user makes among tabs **114**. Here, the user has selected a tab **114**A for "Header". The pane **112** includes multiple input controls **116** which will now be described.

An input control **116**A provides that the user can enter a title for the RFP. Currently, the user has typed "Monthly Office Supply Sourcing." An input control **116**B provides that the user can enter a further description for the RFP. Here, the user has not added any description in the control **116**B. An input control **116**C provides that the user can specify an organizational unit for the RFP. Here, the user has not specified any organizational unit in the control **116**C. An input control **116**D provides that the user can specify a location for the RFP. Currently, the user has entered "Boston Office" in

the control **116**D. An input control **116**E provides that the user can specify a product category for the RFP. Currently, the user has specified "Office supplies" in the control **116**E. An input control **116**F provides that the user can specify an external category for the RFP. Here, the user has not specified any external category in the control **116**F. An input control **116**G provides that the user can specify an estimated value for the RFP. Here, the user has not specified any estimated value in the control **116**G. An input control **116**H provides that the user can specify a budgeted value for the RFP. Currently, the user has entered $2,500,000 in the input control **116**H. An input control **116**I provides that the user can specify a round name for the RFP. Here, the user has not specified any round name in the control **116**I. An input control **116**J provides that the user can specify a default rank for responses to the RFP. Here, the user has specified "Total Cost" as the default rank in the input control **116**J.

An area **118** in the pane **112** specifies the general status for the RFP.

An area **120** in the pane **112** specifies one or more collaborators that have been tied to the RFP being created.

An area **122** in the pane **112** provides that the user can add one or more document links to the RFP.

An area **124** of the pane **112** shows a change history for the RFP.

After working with the pane **112**, the user can choose another one of the tabs **114** or close the RFP using the toolbar **110**.

With reference now also to FIG. 1C, the UI **100** here shows a pane **126** that is presented when the user chooses a tab **114**B called "Schedule". The pane **126** here includes input controls **128** for specifying one or more phases for the RFP.

An area **130** of the pane **126** includes input controls **132** relating to standard dates. An input control **132**A provides that the user can specify a planned open date for the RFP, and an input control **132**B provides that the user can specify that a phase change should automatically take place on the planned open date. Here, the user has not made any entries in the controls **132**A-B. An input control **132**C provides that the user can specify an intention-to-respond date for the RFP. Here, the user has not entered any date in the control **132**C. An input control **132**D provides that the user can specify a response due date for the RFP. Currently, the user has entered Dec. 31, 2010, at 6.00 P.M. in the control **132**D. Input controls **132**E provide that the user can choose to activate or deactivate various options for the RFP. Here, the user has not made any selections in the controls **132**E. An input control **132**F provides that the user can specify a date when a notice for the RFP is to be published, and a control **132**G allows the user to publish the notice to all suppliers. Here, the user has not made any entries in the controls **132**F-G. An input control **132**H provides that the user can specify a base date for the RFP. Here, the user has entered Dec. 1, 2010, in the control **132**H.

The pane **126** includes an area **134** where the user can maintain or modify schedule items for the RFP.

After working with the pane **126**, the user can choose another one of the tabs **114** or close the RFP using the toolbar **110**.

With reference now also to FIG. 1D, the UI **100** here shows a pane **136** that is presented when the user chooses a tab **114**C called "Suppliers". The pane **136** here includes input controls **138** for specifying one or more invited suppliers for the RFP. Here, the user has entered four invited suppliers.

The pane **136** also includes an input control **140** for setting disclosure rules for the RFP with regard to the invited supplier(s), and an input control **142** for attaching one or more documents to the supplier invitation(s).

Finally, the pane **136** here includes an area **144** where the user can specify one or more event terms for the RFP. Currently, the user has not specified any event terms in the area **144**.

After working with the pane **126**, the user can choose another one of the tabs **114** or close the RFP using the toolbar **110**.

For example, if the user selects a tab **114D** called "Questions," a display such as that of FIG. 1E can be presented. With reference now also to FIG. 1E, the UI **100** here shows a pane **146** that allows the user to change or choose one or more questions to be posed in the RFP. The pane **146** here includes input controls **148**, each of which corresponds to a separate question.

After working with the pane **126**, the user can choose another one of tabs **150** or close the RFP using the toolbar **110**.

With reference again briefly to FIG. 1D, if the user selects a tab **114E** called "Line Items," a display such as that of FIG. 1F can be presented. Here, a pane **152** includes input control **154** for changing or choosing one or more line items for the RFP. Currently, four line items are listed in the input control **154**. Each line item is specified by multiple aspects, such as by a control **154A** for a brief description, a control **154B** for a delivery date, and a control **154C** for quantity, to name a few examples.

After working with the pane **152**, the user can choose another one of tabs **114** or close the RFP using the toolbar **110**.

Thus, the above example illustrates a number of different panes and input controls that are available when creating a business document, for example an RFP. Also, in this example the user created the RFP without visiting some of the tabs **114**, and without using some of the input controls on the respective panes.

SUMMARY

This document describes systems and techniques that leverage information that an application already knows, or has access to, in order to aid in producing a better user experience that allows users to more efficiently do their job. For example, a user interface can automatically be personalized. As another example, inferred best practices can automatically be implemented or suggested to a user. Any or all of these can be performed on-the-fly at runtime, without modifying the application code.

In some implementations, usage information is gathered by tracking user behavior data in the system having the application(s) implemented. By routing this same usage information back into a development organization, the usability of the application can be further improved by revealing real-world issues and inefficiencies to the application's product team.

In a first aspect, a computer-implemented method for automatically personalizing applications includes: receiving, in a computer system, user behavior data for multiple users of at least one application program, the application program having a user interface with multiple input controls displayed on multiple different panes, and the user behavior data reflecting actions performed using the input controls on the panes; identifying, using the computer system, at least one usage pattern in the user behavior data as meeting a usage pattern criterion; storing a personalization record based on identifying the usage pattern, the personalization record specifying the usage pattern as a sequence of activating at least some of the input controls on at least some of the panes; and automati-

cally generating, using the computer system and based on the personalization record, a modified user interface according to the identified usage pattern.

In a second aspect, a computer program product tangibly embodied in a computer-readable storage medium includes instructions that when executed by a processor perform a method for personalizing applications. The method includes: receiving, in a computer system, user behavior data for multiple users of at least one application program, the application program having a user interface with multiple input controls displayed on multiple different panes, and the user behavior data reflecting actions performed using the input controls on the panes; identifying, using the computer system, at least one usage pattern in the user behavior data as meeting a usage pattern criterion; storing a personalization record based on identifying the usage pattern, the personalization record specifying the usage pattern as a sequence of activating at least some of the input controls on at least some of the panes; and generating, using the computer system and based on the personalization record, a modified user interface according to the identified usage pattern.

In a third aspect, a computer system includes: a processor; a display device; and a computer readable storage device having stored therein: at least one application program having a user interface with multiple input controls displayed on multiple different panes; user behavior data for multiple users of the application program, the user behavior data reflecting actions performed using the input controls on the panes; and instructions that when executed by the processor generate an analyzer module that identifies at least one usage pattern in the user behavior data as meeting a usage pattern criterion, and stores a personalization record based on identifying the usage pattern, the personalization record specifying the usage pattern as a sequence of activating at least some of the input controls on at least some of the panes; wherein the computer system generates, based on the personalization record, a modified user interface for the application program according to the identified usage pattern.

Implementations can include any or all of the following features. Generating the modified user interface comprises hiding at least one of the input controls or panes. Generating the modified user interface further comprises generating a guided visual procedure for the application program, the guided visual procedure generated based on the personalization record. The modified user interface includes a control for viewing the user interface. The usage pattern criterion requires that a majority of the multiple users employed the usage pattern. The usage pattern criterion requires that the usage pattern be faster performed than other usage patterns, or that the usage pattern involve fewer panel revisits than the other usage patterns. The method further includes automatically adding by the computer system information in at least one of the input controls, the information obtained from the identified usage pattern.

Implementations can provide any or all of the following advantages. A personalization process is automated by evaluating how users actually use one or more applications. The "wisdom of crowds" and the "network effect" are leveraged to automatically personalize an application and propose a best-practice usage pattern.

The details of one or more implementations are set forth in the accompanying drawings and the description below. Other features and advantages will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

FIGS. 1A-F show a prior art user interface for an application program.

FIG. **2** shows an example of a personalized user interface for the application program.

FIGS. **3**A-C show examples of a personalized user interface with a guided visual procedure.

FIG. **4** shows an example of a system that can generate a personalized user interface for an application program.

FIG. **5** shows an example of user behavior data.

FIG. **6** is a block diagram of a computing system that can be used in connection with computer-implemented methods described in this document.

Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

Implementations to be described in examples herein make use of knowledge about user behavior to simplify or enhance or otherwise improve an application interface for one or more users. The more users whose actions have been collected, and the broader the set of usage scenarios that are covered by the behavior tracking, the better the user experience can be personalized for any particular user. In an ERP system, for example, the backend application server knows about everything that is occurring in the application among multiple users at different locations. At any given time, the server knows how many users are on the system, where they are at in the application, how long they have been on the current screen, where they came from, which features they are using, what types of events they are creating, which fields they are using, and what types of errors they run into, to name just a few examples.

This substantial wealth of information is tapped into for one or more purposes. In some implementations, historical and current usage information is correlated across a large number of users. One result thereof is that one can begin to extrapolate optimal usage patterns and best practice event setups. For example, given a user who has a recurring sourcing project for office supplies, the system can keep metrics about how this user is interacting with the system and executing the event. After executing similar events up to the point where the system reaches a defined data collection threshold for the usage patterns, it will have enough information to optimize the application for this specific user whenever he or she creates sourcing events of this type. As another example, the system can reflow the UI to better group required fields together, to eliminate navigation steps, and/or to remove elements that were never used when any user sourced this category of goods.

Best practices scenarios can be created based on captured usage patterns and statistics for many users. If a sufficient number of users have sourced the same category of goods and there are enough commonalities in how they execute the project, a usage pattern can be identified and the system can automatically identify this as a best practice scenario for the sourcing process (the "best practice" for short). Thus, even if a current user has never created a sourcing project for a given category of item, the best practice can be offered as a support and guidance to the user. For example, in the procedure of creating the sourcing project, the user can be presented with the option of automatically using a best practice or starting from scratch.

In some implementations, the application can further take advantage of usage information to which the backend server already has access. For example, if users are spending a lot of time in one particular area of the application, this could be an indicator to the product team that that this area needs to be redesigned. As another example, if users always trigger errors in a particular area of the application, this can provide an opportunity to present personalized help content. This is also an example of a product team reusing usage information to further refine an application with the goal of eliminating the problem of adding new complexities with each release. Instead, this endeavor seeks to provide future releases that optimized, streamlined, and made leaner in accordance with how customers actually use the application.

The following example illustrates an improvement in the UI for the sourcing project that can be automatically created based on tracking user behavior regarding the application program. FIG. **2** shows an example of a personalized UI **200** for the application program. The UI **200** here includes tabs **202** that allow the user to choose between different panes. In some implementations, the tabs **202** are included in the UI **200** as a subset of the tabs **102** (FIGS. **1**A-F). For example, the tabs **202** here include the tab **114**A (currently selected), the tab **114**C and the tab **114**E.

The UI **200** here also includes some, but not all, of the input controls that were mentioned above for the UI **100** (FIGS. **1**A-F). For example, the UI **200** includes the following: input controls **116**A, **116**D, **116**E, **116**H, **116**J, **132**D, and **138**, and also the areas **120** and **124**, each of which includes at least one input control.

After working in the tab **114**A, the user can select any of the other tabs **202** (e.g., the tab **114**C or **114**E), or can close the RFP using the toolbar **110**.

Accordingly, the UI **200** provides a simplified and streamlined UI for creating a source request, which UI was automatically created by analyzing one or more usage patterns of those who use the same application program.

The UI **200** can include a review control **204** which can be used to toggle between the UI **200** and the corresponding pane or panes in the UI **100** (FIGS. **1**A-F). For example, upon reviewing the suppliers listed in the control **138** a user might think that it would be helpful to see the context where this information has been entered in the past. The user can therefore activate the button **204** to cause the system to change the user interface. In this example, the user may then be presented with the pane **136** (FIG. **1**D). When the pane **136** or any other pane is presented as a result of the button **204**, the pane may have a corresponding control (not shown) for toggling back to the UI **200** or any other personalized UI.

In some implementations, the modified UI includes a guided procedure that is designed based on one or more usage patterns. FIGS. **3**A-C show examples of a personalized UI **300** with a guided visual procedure. The UI **300** includes a Back/Next control **302** by which the user can navigate to any and all panes in the UI **300**. Currently, a pane **304** is presented in the UI **300**. The pane **304** includes input controls **306** regarding the project; i.e., regarding the request document that is being created. Here, the input controls **306** include the controls **116**A, **132**D and **116**H. For example, these controls have been assembled together based on a usage pattern identified in tracked user behavior data.

The UI **300** also includes an area **308** that in this example is related to content that was otherwise presented under the tab **114**E (FIG. **1**F). For example, the area **308** can include one or more input controls **310** for entering a brief description of a line item to be covered by the business document (e.g., by the RFP). Here, the user has specified four line items.

After entering each description, the user may be presented with a separate pane for the specifics of that line item. With reference now also to FIG. **3**B, a pane **312** is presented. The pane **312** includes single instances of the input controls **154**A (description), **154**B (delivery date) and **154**C (quantity). Accordingly, the user enters the corresponding information

for the line item that is being specified. For example, the pane **312** and/or the guided procedure may have been created because user behavior data showed that users need a more logical UI for specifying line items. Also, the control **310** for specifying line items here appears early in the guided procedure (e.g., on the first screen). This contrasts with the pane **152** (FIG. 1F), which the user might have arrived at late in the process if the user proceeded through the corresponding tabs in order. Accordingly, the earlier placement of the input controls for line items can be a result of observing, in tracked usage patterns, that users prefer to specify the line item(s) early in the process.

When the user is done with the pane **312**, the user can specify another line item in a similar way using the pane **312**, or continue working in the pane **304**.

FIG. 3C shows a pane **314** that summarizes the business document (e.g., the RFP) in its current state. In some implementations, the pane **314** includes an area **316** that contains description of the business document; the area **308** for the line items; and an area **318** that summarizes the listed supplier(s) for the business document.

The area **318** can be populated with information about suppliers in one or more different ways. For example, in the tracked usage data the system may have detected a consistent set of suppliers that were always selected with a high degree of probability for events of this category (e.g., RFPs). Therefore the system would automatically add those detected suppliers to the area **318**, and not provide any selection screens in the guided procedure steps. Instead, the detected suppliers would be shown only on the final confirmation screen. On that screen (i.e., in the area **318**), the user can add or remove suppliers, or the user can keep the system-recommended suppliers. This keeps the process and steps lean and efficient.

In some implementations, some or all of the information in the area **318** is explicitly entered by the user. For example, each of the suppliers listed in the area **318** may have been entered in an iterative procedure similar to that described above for the line items (FIGS. 3A-B). The system may have chosen to create the iterative procedure upon detecting enough variance in the set of suppliers when analyzing the tracked usage data.

Data that is never or only very rarely used can be hidden or omitted. For example, the input controls **138** (FIG. 2) included columns labeled "Supplier ID" and "Status," but these columns are not visible in the area **318**.

Accordingly, the panes **304**, **312** and **314** provide a guided procedure for creating a business document, and this procedure may correspond to a best practice that has been identified or otherwise established for such business document(s).

FIG. 4 shows an example of a system **400** that can generate a personalized user interface for an application program. Here, the system **400** includes a computer device **402** that can communicate with any or all user devices **404** through any kind of network **406**, such as a local computer network or the internet. The devices can include any processor-based technology. The computer device **402** can include an application server, and the user devices **404** can include personal computers, laptops, and/or mobile devices such as smartphones, to name just a few examples.

The computer device **402** has one or more application programs **408** installed thereon. In some implementations, one or more of the application programs **408** include an ERP application. For example, the application program **408** can be designed to generate business documents, such as the requests mentioned in examples above.

Users of the user devices **404** interact with the application program(s) in one or more ways, for example to perform ERP

functions. The computer system **402** includes a tracking module **410** that documents or otherwise registers some or all of the users' actions. In some implementations, any or all actions that the UI **100** (FIG. 1A-F) is designed to support can be tracked. For example, the tracking module **410** can have at least one specification **412** that identifies one or more types of action that is to be tracked.

In some implementations, the tracking module **410** tracks whether the users add publicly available content to events. For example, if users choose suppliers from an available supplier repository, then the specification **412** can indicate that the set of suppliers that users choose from the repository should be tracked. One result of tracking such data is that event documents can be pre-populated with content. Such pre-population can be done in addition to, or instead of, reflowing and personalizing the user interface. In some implementations, the best practice is a combination of optimized user experience and proposed content. To ensure that information collection does not interfere with users' privacy rights or trade secrets, this tracking is either done only when the tracking is known to be allowed, or an opt-in mechanism is used for some types of data.

Thus, the tracking module **410** can monitor events in the application program(s) **408** and register user-specific actions that are named in the specification **412**. The tracking module **410** can store or otherwise memorialize the tracked activities in a user behavior repository **414**, such as a database or a storage facility.

The tracking module **410** can store the user behavior data in any suitable format, organization or structure. In some implementations, the user behavior data when captured contains the basic information about what user took what action, and when. Accordingly, the user behavior repository **414** can store raw tracking data organized by one or more of user identity, action name, and timestamp.

In some implementations, the user behavior data can be processed in one or more ways. The usage data for each user can be organized by the actions regardless of the order in which the user performed them, and/or the amount of time spent per action can be calculated. For example, the time that elapses from the moment the user performs one action until the next individually tracked action can be defined as the amount of time that the user spent on performing the latter action.

FIG. 5 shows an example of user behavior data **500**. In this example, the user behavior data **500** is based on actions taken by N users of the same application program, here called $User_1$ through $User_N$, respectively. That is, these actions are tracked while the users are using an unmodified version of the UI, such as the UI **100** (FIGS. 1A-F). Moreover, the application program in this example has M aspects for which actions are tracked, here called $Aspect_1$ through $Aspect_M$, respectively. In some implementations, the M aspects are tracked because they are the ones listed in the specification **412** (FIG. 4). For example, any of the input controls described above can be one of the aspects.

For each user, the user behavior data **500** has a column **502** that specifies the order in which the user worked on each particular aspect is performing the procedure. That is, for $User_1$ the user behavior data **500** shows that the first listed aspect (i.e., $Aspect_1$) was the 28th action detected for this user in the tracking, and the third aspect was the last (i.e., Mth) action detected. A column **504** specifies the time that the user spent on the particular aspect. For example, $User_2$ spent 8 minutes working on (and/or viewing) the $Aspect_3$.

The user behavior data **500** has a row **506** that shows the total cumulative time for each user. For example, the $User_2$

spent a total of 19 minutes in performing the tracked actions of the current application program.

Some tracked aspects were not used when the user behavior data **500** was collected. For example, none of the shown users (i.e., User₁, User₂, User₃ and User_N) used the fourth aspect. As another example, User₃ did not use the first aspect.

Other ways of organizing or processing the user behavior data can be used.

With reference now again to FIG. **4**, the computer device **402** includes an analyzer module **416** that analyzes the user behavior data **414**. In some implementations, the analyzer module **416** looks for one or more usage patterns in the user behavior data **414**.

Any useful usage pattern can be detected. In some implementations, the order in which different users perform actions is taken into account. For example, if many users perform a certain action first, or otherwise early, in the process, this can be identified as a usage pattern. As another example, if many users omit a certain action in the process, this can be identified as another usage pattern. In some implementations, the time users spend on various aspects of the application program are taken into account. Usage patterns can be specified by one or more usage pattern criteria **418**. That is, the analyzer module **416** can read or otherwise access at least one of the usage pattern criteria **418** and analyze the user behavior data **414** to see if it meets the criterion or criteria.

A usage pattern can be based on fewer than all of the tracked users. In some implementations, one or more thresholds (e.g., a majority rule) are defined for the criterion. For example, the threshold for omitting a UI aspect can be set relatively high, such as at 99% or above. That is, if it is detected that 99% or more of the users skip a particular aspect, only then is the criterion for a usage pattern satisfied so that the aspect will be removed (akin to how some input controls from FIGS. **1**A-F were omitted in the UIs **200** and/or **300**).

As another example, the threshold for rearranging a UI aspect can be set relatively lower that the omission criterion, such as at 45% or above. That is, if it is detected that 45% or more of the users perform a particular action first or early in the sequence, then the UI can automatically be modified to ensure that this aspect is visible to the user at the beginning of the process. For example, in the UI **200** (FIG. **2**), note how the controls **138** were located on the "Header" pane; as another example, in the UI **300** (FIGS. **3**A-C), note how the "line items" guided procedure was launched already from the first pane **304**.

Other thresholds and/or criteria can be used. For example, it can be taken into account which user(s) finished the process (e.g., of creating a business document) the fastest. The order in which these users performed the actions can be defined as a best practice scenario. As another example, among the users who are the slowest to complete the process, one or more common characteristics can be identified, such as: "the user performed the action X only at the very end, which in turn made it necessary to perform multiple updates elsewhere."

Here, the analyzer module **416** generates one or more personalization record **420** based on the analysis. In some implementations, the personalization record **420** is created to reflect one or more usage patterns that have been identified in the user behavior data **414**, and can contain specific executable instructions for modifying the UI. For example, the personalization record **420** can define a best pattern scenario for creating a business document. As another example, the personalization record **420** defines what input controls of the UI **100** (FIGS. **1**A-F) that should be omitted when generating the UI **200** (FIG. **2**) and/or the UI **300** (FIGS. **3**A-C). The personalization record **420** can also include the code or other

instructions for switching between the old and new UI, for example in response to the user activating the button **204** (FIGS. **2**, **3**).

FIG. **6** is a schematic diagram of a generic computer system **600**. The system **600** can be used for the operations described in association with any of the computer-implement methods described previously, according to one implementation. The system **600** includes a processor **610**, a memory **620**, a storage device **630**, and an input/output device **640**. Each of the components **610**, **620**, **630**, and **640** are interconnected using a system bus **650**. The processor **610** is capable of processing instructions for execution within the system **600**. In one implementation, the processor **610** is a single-threaded processor. In another implementation, the processor **610** is a multi-threaded processor. The processor **610** is capable of processing instructions stored in the memory **620** or on the storage device **630** to display graphical information for a user interface on the input/output device **640**.

The memory **620** stores information within the system **600**. In some implementations, the memory **620** is a computer-readable medium. The memory **620** is a volatile memory unit in some implementations and is a non-volatile memory unit in other implementations.

The storage device **630** is capable of providing mass storage for the system **600**. In one implementation, the storage device **630** is a computer-readable medium. In various different implementations, the storage device **630** may be a floppy disk device, a hard disk device, an optical disk device, or a tape device.

The input/output device **640** provides input/output operations for the system **600**. In one implementation, the input/output device **640** includes a keyboard and/or pointing device. In another implementation, the input/output device **640** includes a display unit for displaying graphical user interfaces.

The features described can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. The apparatus can be implemented in a computer program product tangibly embodied in an information carrier, e.g., in a machine-readable storage device, for execution by a programmable processor; and method steps can be performed by a programmable processor executing a program of instructions to perform functions of the described implementations by operating on input data and generating output. The described features can be implemented advantageously in one or more computer programs that are executable on a programmable system including at least one programmable processor coupled to receive data and instructions from, and to transmit data and instructions to, a data storage system, at least one input device, and at least one output device. A computer program is a set of instructions that can be used, directly or indirectly, in a computer to perform a certain activity or bring about a certain result. A computer program can be written in any form of programming language, including compiled or interpreted languages, and it can be deployed in any form, including as a stand-alone program or as a module, component, subroutine, or other unit suitable for use in a computing environment.

Suitable processors for the execution of a program of instructions include, by way of example, both general and special purpose microprocessors, and the sole processor or one of multiple processors of any kind of computer. Generally, a processor will receive instructions and data from a read-only memory or a random access memory or both. The essential elements of a computer are a processor for executing instructions and one or more memories for storing instructions and data. Generally, a computer will also include, or be

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operatively coupled to communicate with, one or more mass storage devices for storing data files; such devices include magnetic disks, such as internal hard disks and removable disks; magneto-optical disks; and optical disks. Storage devices suitable for tangibly embodying computer program instructions and data include all forms of non-volatile memory, including by way of example semiconductor memory devices, such as EPROM, EEPROM, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM and DVD-ROM disks. The processor and the memory can be supplemented by, or incorporated in, ASICs (application-specific integrated circuits).

To provide for interaction with a user, the features can be implemented on a computer having a display device such as a CRT (cathode ray tube) or LCD (liquid crystal display) monitor for displaying information to the user and a keyboard and a pointing device such as a mouse or a trackball by which the user can provide input to the computer.

The features can be implemented in a computer system that includes a back-end component, such as a data server, or that includes a middleware component, such as an application server or an Internet server, or that includes a front-end component, such as a client computer having a graphical user interface or an Internet browser, or any combination of them. The components of the system can be connected by any form or medium of digital data communication such as a communication network. Examples of communication networks include, e.g., a LAN, a WAN, and the computers and networks forming the Internet.

The computer system can include clients and servers. A client and server are generally remote from each other and typically interact through a network, such as the described one. The relationship of client and server arises by virtue of computer programs running on the respective computers and having a client-server relationship to each other.

A number of implementations have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of this disclosure. Accordingly, other implementations are within the scope of the following claims.

What is claimed is:

1. A computer-implemented method for automatically personalizing applications, the method comprising:

providing, by a computer system, a first page for display as part of a first user interface of a particular application program, wherein the first page includes:

(i) multiple first input controls, including a first input control, with which users are able to interact in order to specify information for input to the computer system, and

(ii) a first navigation control that, when selected, causes navigation to a second page of the particular application program;

receiving, by the computer system, first data that indicates that a user selected one or more of the multiple first input controls wherein the first data indicates that the user selected the first input control;

receiving, by the computer system, an indication that the user selected the first navigation control to navigate to the second page;

providing, by the computing system and in response to having received the indication that the user selected the first navigation control, the second page for display as part of the first user interface, wherein the second page includes multiple second input controls, including a sec-

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ond input control, with which the user is able to interact in order to specific information for input to the computer system;

receiving, by the computer system, second data that indicates that the user selected one or more of the multiple second input controls wherein the second data indicates that the user selected the second input control;

analyzing, by the computer system, the received first data and the received second data in order to identify a particular sequence of interactions with at least the first input control and the second input control;

storing, by the computer system, information that specifies the particular sequence of interactions with at least the first input control and the second input control;

automatically generating, by the computer system and based on an analysis of the information that specifies the particular sequence of interactions with the at least first input control and the second input control, a second user interface that provides for display, in a single page of the second user interface and at the same time:

(i) a review control, and

(ii) the first input control and the second input control positioned on the single page in an order that is specified by the particular sequence of interactions and that is different than an order of the multiple first input controls provided for display in the first page and the multiple second input controls provided for display in the second page of the first user interface, wherein generating the second user interface includes locating the second input control before the first input control on the single page of the second user interface, and does not include a third input control from the multiple first input controls or the multiple second input controls, on the single page of the second user interfaces;

receiving, by the computer system, data indicating selection of the review control that was displayed in the single page of the second user interface; and

providing, by the computer system and based on receiving the data indicating selection of the review control, the first user interface for display, including a display of (i) the first page with the first input control and the third input control, or (ii) the second page with the second input control and the third input control.

2. The computer-implemented method of claim 1, wherein automatically generating the second user interface comprises generating a guided visual procedure for display to the user in order to guide an input of information by the user into the computer system.

3. The computer-implemented method of claim 1, wherein: at least one of the multiple first input controls or at least one of the multiple second input controls comprises an input field configured to permit user entry of information into the input field.

4. The computer-implemented method of claim 1, wherein analyzing the received first data and the received second data in order to identify the particular sequence of interactions comprises determining, by the computer system, that the particular sequence of interactions has been performed faster than other of the sequences with which multiple users interacted with the multiple first input controls and the multiple second input controls.

5. The computer-implemented method of claim 1, wherein analyzing the received first data and the received second data in order to identify a particular sequence of interactions comprises determining, by the computer system, that a number of

users that interacted with the first input control and the second input control in the particular sequence exceeds a threshold number of users.

6. The computer-implemented method of claim **1**, wherein storing, by the computer system, the information that specifies the particular sequence of interactions with at least the first input control and the second input control comprises storing, by the computer system, information that specifies a first amount of time for which the user interacted with the first input control and a second amount of time for which the user interacted with the second input control.

7. The computer-implemented method of claim **1**, wherein storing, by the computer system, the information that specifies the particular sequence of interactions with at least the first input control and the second input control comprises storing, by the computer system, information that specifies an error that occurred as a result of the user interacting with the first input control or the second input control.

8. The computer-implemented method of claim **1**, wherein the second page comprises a second navigation control that, when selected, causes navigation to the first page, the method comprising:

receiving, by the computer system, an indication that the user selected the second navigation control to navigate to the first page, wherein receiving the first data that indicates that the user selected one or more of the multiple first input controls comprises receiving the first data that indicates the user selected one or more of the multiple first input controls after receiving the indication that the user selected the second navigation control to navigate to the first page.

9. A computer program product tangibly embodied in a non-transitory computer-readable storage medium and comprising instructions that when executed by a processor perform a method for personalizing applications, the method comprising:

providing, by a computer system, a first page for display as part of a first user interface of a particular application program, wherein the first page includes:

(i) multiple first input controls, including a first input control, with which users are able to interact in order to specify information for input to the computer system, and

(ii) a first navigation control that, when selected, causes navigation to a second page of the particular application program;

receiving, by the computer system, first data that indicates that a user selected one or more of the multiple first input controls wherein the first data indicates that the user selected the first input control;

receiving, by the computer system, an indication that the user selected the first navigation control to navigate to the second page;

providing, by the computing system and in response to having received the indication that the user selected the first navigation control, the second page for display as part of the first user interface, wherein the second page includes multiple second input controls, including a second input control, with which the user is able to interact in order to specific information for input to the computer system;

receiving, by the computer system, second data that indicates that the user selected one or more of the multiple second input controls wherein the second data indicates that the user selected the second input control;

analyzing, by the computer system, the received first data and the received second data in order to identify a par-

ticular sequence of interactions with at least the first input control and the second input control;

storing, by the computer system, information that specifies the particular sequence of interactions with at least the first input control and the second input control;

automatically generating, by the computer system and based on an analysis of the information that specifies the particular sequence of interactions with the at least first input control and the second input control, a second user interface that provides for display, in a single page of the second user interface and at the same time:

(i) a review control, and

(ii) the first input control and the second input control positioned on the single page in an order that is specified by the particular sequence of interactions and that is different than an order of the multiple first input controls provided for display in the first page and the multiple second input controls provided for display in the second page of the first user interface, wherein generating the second user interface includes locating the second input control before the first input control on the single page of the second user interface, and does not include a third input control from the multiple first input controls or the multiple second input controls, on the single page of the second user interfaces;

receiving, by the computer system, data indicating selection of the review control that was displayed in the single page of the second user interface; and

providing, by the computer system and based on receiving the data indicating selection of the review control, the first user interface for display, including a display of (i) the first page with the first input control and the third input control, or (ii) the second page with the second input control and the third input control.

10. The computer program product of claim **9**, wherein automatically generating the second user interface comprises generating a guided visual procedure for display to the user in order to guide an input of information by the user into the computer system.

11. The computer program product of claim **9**, wherein:

at least one of the multiple first input, controls or at least one of the multiple second input controls comprises an input field configured to permit user entry of information into the input field.

12. The computer program product of claim **9**, wherein analyzing the received first data and the received second data in order to identify the particular sequence of interactions comprises determining, by the computer system, that the particular sequence of interactions has been performed faster than other of the sequences with which multiple users interacted with the multiple first input controls and the multiple second input controls.

13. The computer program product of claim **9**, wherein analyzing the received first data and the received second data in order to identify a particular sequence of interactions comprises determining, by the computer system, that a number of users that interacted with the first input control and the second input control in the particular sequence exceeds a threshold number of users.

14. A computer system comprising:

a processor;

a display device; and

a computer readable storage device coupled to the processor having instructions stored thereon which, when executed by the processor, cause the processor to perform operations for personalizing applications, the operations comprising:

providing, by a computer system, a first page for display as part of a first user interface of a particular application program, wherein the first page includes:

    (i) multiple first input controls, including a first input control, with which users are able to interact in order to specify information for input to the computer system, and

    (ii) a first navigation control that, when selected, causes navigation to a second page of the particular application program;

receiving, by the computer system, first data that indicates that a user selected one or more of the multiple first input controls wherein the first data indicates that the user selected the first input control;

receiving, by the computer system, an indication that the user selected the first navigation control to navigate to the second page;

providing, by the computing system and in response to having received the indication that the user selected the first navigation control, the second page for display as part of the first user interface, wherein the second page includes multiple second input controls, including a second input control, with which the user is able to interact in order to specific information for input to the computer system;

receiving, by the computer system, second data that indicates that the user selected one or more of the multiple second input controls wherein the second data indicates that the user selected the second input control;

analyzing, by the computer system, the received first data and the received second data in order to identify a particular sequence of interactions with at least the first input control and the second input control;

storing, by the computer system, information that specifies the particular sequence of interactions with at least the first input control and the second input control;

automatically generating, by the computer system and based on an analysis of the information that specifies the particular sequence of interactions with the at least first input control and the second input control, a second user interface that provides for display, in a single page of the second user interface and at the same time:

    (i) a review control, and

    (ii) the first input control and the second input control positioned on the single page in an order that is specified by the particular sequence of interactions and that is different than an order of the multiple first input controls provided for display in the first page and the multiple second input controls provided for display in the second page of the first user interface, wherein generating the second user interface includes locating the second input control before the first input control on the single page of the second user interface, and does not include a third input control from the multiple first input controls or the multiple second input controls, on the single page of the second user interfaces;

receiving, by the computer system, data indicating selection of the review control that was displayed in the single page of the second user interface; and

providing, by the computer system and based on receiving the data indicating selection of the review control, the first user interface for display, including a display of (i) the first page with the first input control and the third input control, or (ii) the second page with the second input control and the third input control.

15. The computer system of claim **14**, wherein the operation of automatically generating the second user interface comprises generating a guided visual procedure for display to the user in order to guide an input of information by the user into the computer system.

16. The computer system of claim **14**, wherein:

at least one of the multiple first input controls or at least one of the multiple second input controls comprises an input field configured to permit user entry of information into the input field.

17. The computer system of claim **14**, wherein the operation of analyzing the received first data and the received second data in order to identify the particular sequence of interactions comprises determining, by the computer system, that the particular sequence of interactions has been performed faster than other of the sequences with which multiple users interacted with the multiple first input controls and the multiple second input controls.

18. The computer system of claim **14**, wherein the operation of analyzing the received first data and the received second data in order to identify a particular sequence of interactions comprises determining, by the computer system, that a number of users that interacted with the first input control and the second input control in the particular sequence exceeds a threshold number of users.

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